Region 10, 1200 Sixth Avenue, Seattle WA 98101

COLUMBIA RIVER BASIN FISH CONTAMINANT SURVEY

VOLUME I
Appendix A

STUDY DESIGN FOR ASSESSMENT OF CHEMICAL CONTAMINANTS IN FISH CONSUMED BY FOUR NATIVE AMERICAN TRIBES IN THE COLUMBIA RIVER BASIN

January 2002

Prepared by
U.S. Environmental Protection Agency
Region 10
Seattle, Washington

Final Draft Report

Assessment of Chemical Contaminants in Fish Consumed by Four Native American Tribes in the Columbia River Basin

Prepared For:

U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF WATER
OFFICE OF SCIENCE AND TECHNOLOGY
WASHINGTON, D.C.

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1.0 INTRODUCTION

1.1 PROJECT DESCRIPTION

The Columbia River Inter-Tribal Fish commission (CRITFC) entered into a cooperative agreement with the U.S. environmental Protection Agency (EPA) in 1990 to conduct a fish consumption survey of the Nez Perce, Warm Springs, Umatilla, and Yakima Native American Tribes. This consumption survey, which was released in October 1994 (CRITFC 1994), was the first phase of a broader effort to determine the role of fish consumption as an exposure route for waterborne toxics among individuals of these tribes. The second phase will use the information from the consumption survey to design, and implement, a sampling program to collect tissue contaminant data from residence and anadromous fish species consumed by tribal members. It is this phase of the project with which this document is concerned. The third phase, which will determine blood contaminant levels of tribal members, has not been initiated. Collectively, these three components should provide the necessary information for developing an exposure assessment for members of the four CRITFC tribes. Information derived from this exposure assessment may then be used by U.S. EPA and others for developing an assessment of health risks to fish consumers in the four member tribes.

1.2 DOCUMENT PURPOSE AND SCOPE

This scoping document was originally submitted in draft form to members of the CRITFC Task Force (Table 1), other tribal representatives, and selected government agencies. The draft document provided a preliminary study design that served as a starting point for discussions that occurred at a Design Conference held on October 19-20, 1994 in Portland, Oregon, at which a study design for U.S. EPA's Phase II CRITFC exposure study was finalized. This document presents the consensus study design developed at the Design Conference and provides the study objectives, rationale, and study recommendations formulated by attendees of the Design Conference. This document is not intended to be a sampling plan or a quality assurance/quality control plan. Such documents will be prepared prior to initiating the field sampling.

TABLE 1. MEMBERS OF THE TASK FORCE FOR THE CRITFC PROJECT	
Name	**Affiliation**
Jeffrey Bigler, Project Manager	U.S. EPA Headquarters, Office of Water
Rick Albright	U.S. EPA Region X, Water Division
Harriett Amann	Washington Department of Health
Steve Bradbury	U.S. EPA Headquarters, Office of Research & Development
Pat Cirone	U.S. EPA Region X, Environmental Services Division
Dave Cleverly	U.S. EPA Headquarters, Office of Research & Development
Dana Davoli	U.S. EPA Region X, Environmental Service Division
Jerry Filbin	U.S. EPA Headquarters, Office of Policy, Planning and Evaluation
Gene Foster	Oregon Department of Environmental Quality
John Gabrielson	U.S. EPA Region X, Water Division
Clarice Gaylord	U.S. EPA Headquarters, Office of Environmental Equity
Jim Griggs	Warm Springs Tribe
Lynn Hatcher	Yakima Tribe
Gary James	Umatilla Tribe
Ken Kauffman	Oregon Department of Health
Craig McCormick	Washington Department of Ecology
Bruce Mintz	U.S. EPA Headquarters, Office of Water
Cynthia Nolt	U.S. EPA Headquarters, Office of Water
Brian Offord	Washington Department of Ecology
Carol Schuler	U.S. Fish and Wildlife Service
Anne Watanabe	10Columbia River Inter-Tribal Fish Commission
Silas Whitman	Nez Perce Tribe
Don Yon	Oregon Department of Environmental Quality

1.3 STUDY OBJECTIVES

The primary objectives of the Phase II study are to:

- Measure fish contaminant levels for species and fishing locations being utilized by CRITFC member tribes to provide, in conjunction with the CRITFC (1994) fish consumption report, an assessment of fish consumption as an exposure route for waterborne toxics among individuals of these tribes.

- To use the information derived from the exposure assessment to estimate potential health risks to fish consumers in the four CRITFC member tribes.

The objectives for the Phase II study were thoroughly discussed at the Design Conference and consensus was reached for the two primary objectives listed above. Specific details regarding how the collected data will be used to accomplish these objectives will be developed as the Phase II study progresses. Design Conference attendees recommended that the methodology for conducting an assessment of human health for the CRITFC member tribes be clearly delineated, as well as the form in which this information would be conveyed to the public. In particular, questions were raised about whether the data would allow only site-specific exposure assessment, or whether the data could be extrapolated to estimate exposure over larger areas of the Columbia River Basin. It was decided that this issue could not be fully resolved until it was determined whether contaminant levels varied significantly among different collection sites.

The manner in which human health concerns resulting from the Phase II study would be disseminated to the public was also discussed at the Design Conference. Concerns were raised by conference attendees about the potential differences in methodology and presentation of human health information by State Health departments, EPA, and other state regulatory agencies. Design Conference attendees recognized that different agencies would likely utilize the available data to meet their own specific operational mandates, and that the analyses and form of presentation of the data might differ. However, it was generally agreed that all agencies should

strive to keep each other informed about the uses and presentation of any data generated from the Phase II study.

Originally, a secondary objective of the Phase II study was to collect sediment contaminant data from the fish collection sites to aid in the determination of chemical-specific biota-sediment accumulation factors (BSAFs). While Design Conference attendees recognized the utility and merit of collecting this data, it was felt that available resources were insufficient to accomplish the primary objectives and carry out a statistically valid sampling program to determine BSAFs. Therefore, this secondary objective was eliminated in favor of a recommendation that additional resources be allocated, if possible, to determine BSAFs for the Columbia River Basin. Furthermore, there was general acknowledgment that implementation of this recommendation should be preceded by the development of a well planned, statistically valid, study design.

2.0 STUDY DESIGN

This section provides a description and rationale for the study design developed for U.S. EPA's Phase II Columbia River Inter-Tribal Fish Commission (CRITFC) exposure study. The study design was developed through a consensus process that considered the objectives presented in Section 1.3. The information used in developing this study design included the fish consumption data provided in the CRITFC (1994), existing data on chemical concentrations in fish tissue within the Columbia River Basin collected from 1984 - 1994, and the results of a human health risk-based screening analysis of the existing data. The main constraint on the study design was the resources available for dioxin and PCB congener analysis of tissue and sediment samples ($250,000).

2.1 SELECTION OF SAMPLING LOCATIONS

Figure 1 illustrates the decision process that was used to select the sampling sites for both resident and anadromous fish species. Initially, fishing sites that represented greater than 40 percent of each tribe's fishing use for resident and anadromous fish species were identified. The 22 fishing locations for resident species that met this criterion were located in the Clearwater, Deschutes, and Umatilla watersheds, and the mainstem Columbia River below McNary Dam (Figure 2). For anadromous species, the same 22 locations plus 4 additional sites located in the mainstem Columbia River upstream from the mouth of the Snake River to Rocky Reach Dam represented greater that 40 percent of the fishing use (Figure 3). To reduce the number of sites to a number consistent with the resources available for the Phase II sampling effort, the distribution of fishing sites exceeding the 40 percent use criterion was subdivided into two categories: watersheds with multiple fishing sites (i.e., Clearwater, Deschutes, and Umatilla), and mainstem Columbia River segments represented by a single fishing site (fishing sites 5-9, 15, 16, and 18). For the three watersheds with multiple fishing sites, a single site located near the base of the watershed (i.e., a second order river segment) was selected to be representative of other fishing sites within the watershed. The three sites that meet this criterion are fishing sites 98, 30, and

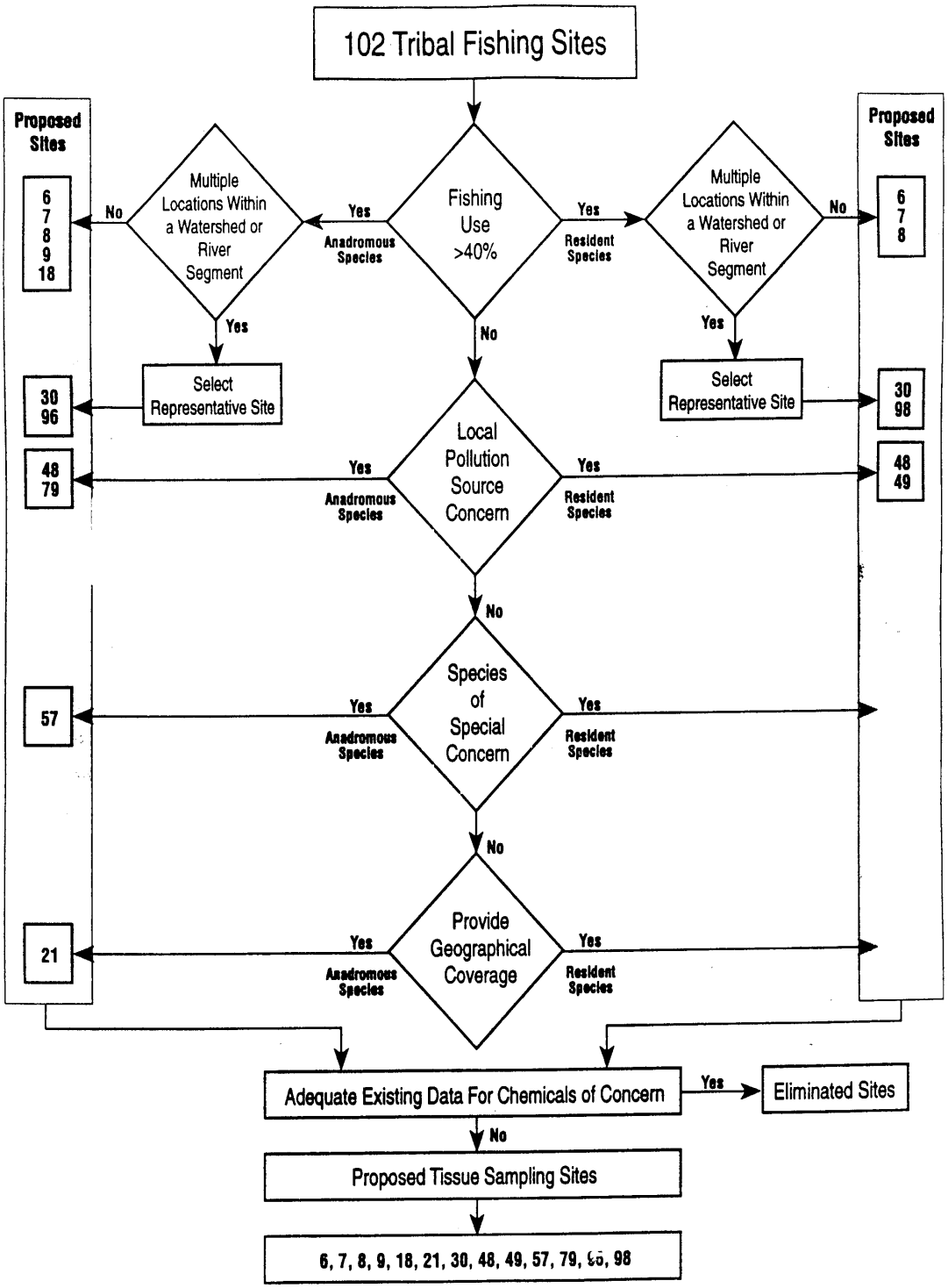

Figure 1. Decision Tree For Selection of Tissue Sampling Sites

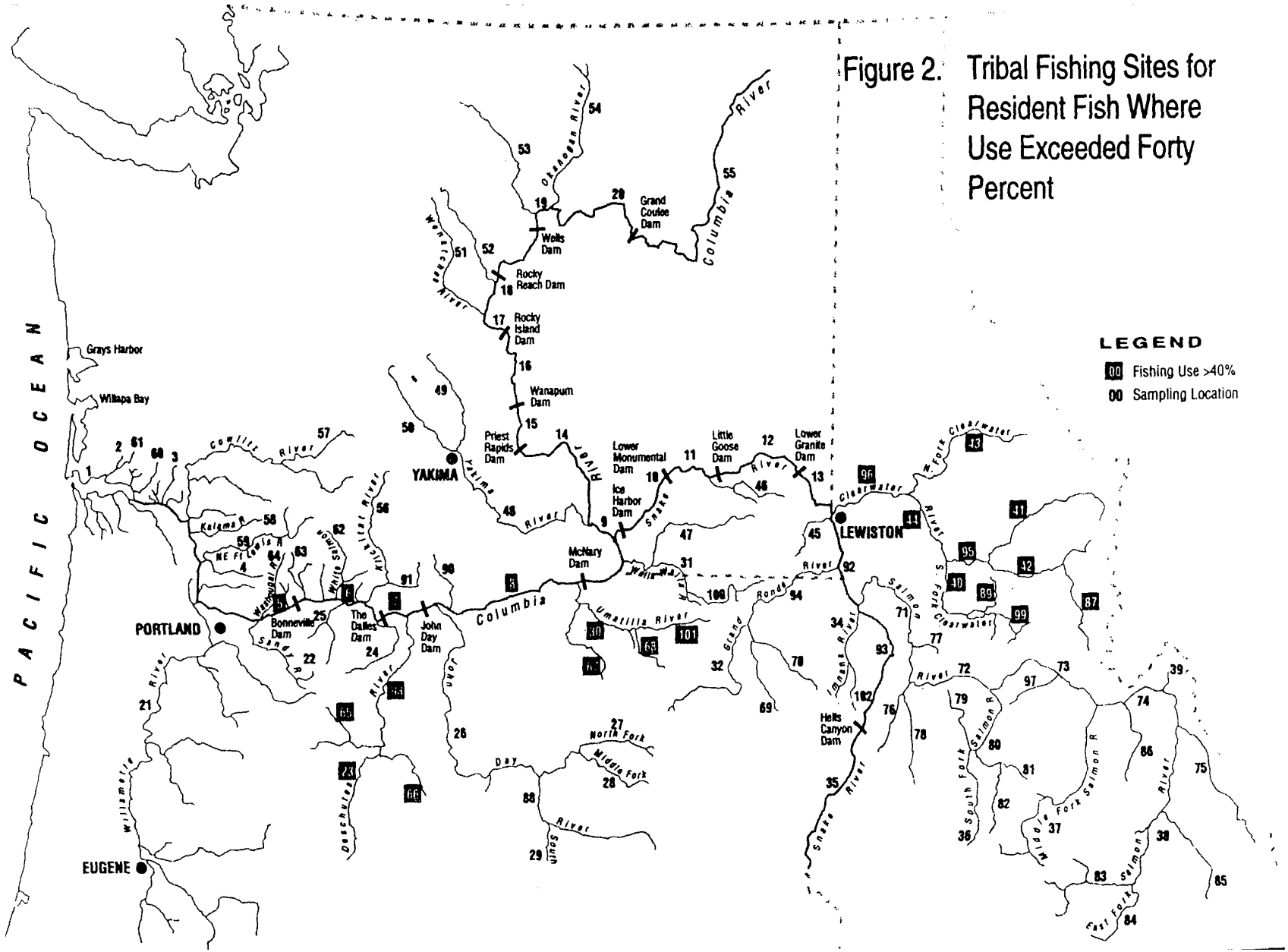

Figure 2. Tribal Fishing Sites for Resident Fish Where Use Exceeded Forty Percent

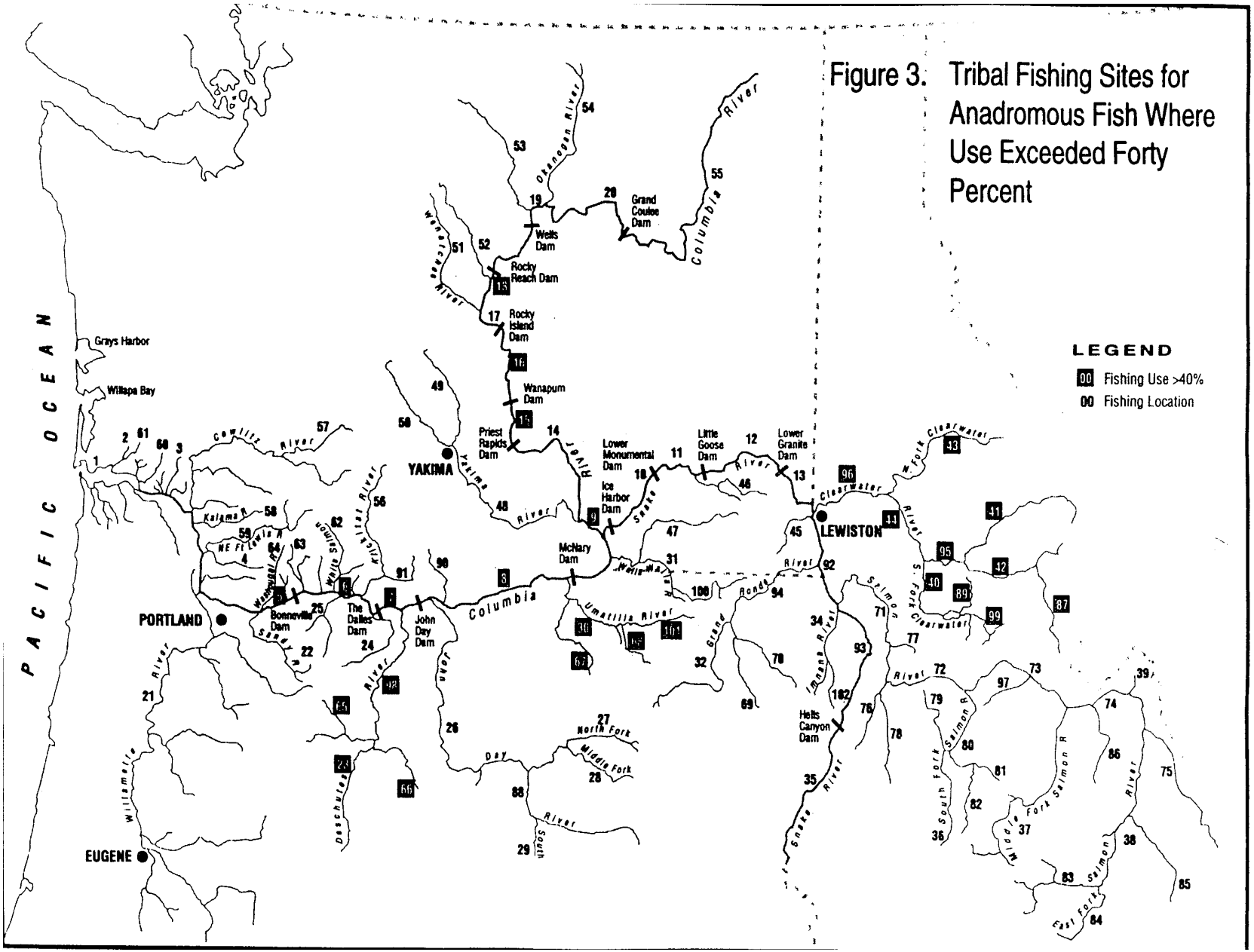

Figure 3. Tribal Fishing Sites for Anadromous Fish Where Use Exceeded Forty Percent

96 located in the Deschutes, Umatilla, and Clearwater Rivers, respectively (Figure 4). The assumption that these three sites will be representative of other fishing sites within each watershed is probably reasonable for anadromous species, but may not hold for resident species depending on local sources of contaminants and the ranges of the resident species being considered. The decision to analyze contaminant levels in resident species at the same sites as anadromous species was based on considerations of sampling logistics, and the desire to compare contaminant levels between both categories of fish.

Eight fishing sites in the mainstem of the Columbia River are located in river segments separated by dams. Sites 6, 7, and 8 were selected because they represented greater than 40 percent of the Yakima fishing use for both resident and anadromous species (Figure 4). Site 5, which also met these use criteria, was not selected because of the need to reduce the number of sampling locations, and because of the large amount of recent fish contaminant data that have been collected by Lower Columbia River Water Quality Bi-State Program in the vicinity of this site (Tetra Tech 1993; 1994a, b). Sites 9, 15, 16, and 18 are Columbia River mainstem sites that represent greater than 40 percent of the Yakima fishing use for anadromous species. Site 9 was selected by the Yakima representative due to its frequent use for fishing. Site 18 was selected because it represented the most upstream location with frequent fishing use. Fish collected at this site would presumably have the maximum exposure duration to contaminants within the mainstem Columbia River. Sites 15 and 16, which are located in the stretch of water between sites 9 and 18, were not selected because of the need to reduce the number of sites sampled.

Three sites (48, 49, and 79) were selected by tribal representatives because of concern about local pollution sources (Figure 4). Fishing use of these sites by tribal members is less than 20 percent. Sites 48 (Marion Drain) and 49 (Wilson Creek) are located in the Yakima River. There is concern that both of these sites have been adversely impacted from pesticide runoff (Hatcher, L., 28 September 1994, personal communication). Site 49 is also an important spawning site for rainbow trout. Site 79 is located in the Salmon River watershed in the vicinity of a mining operation.

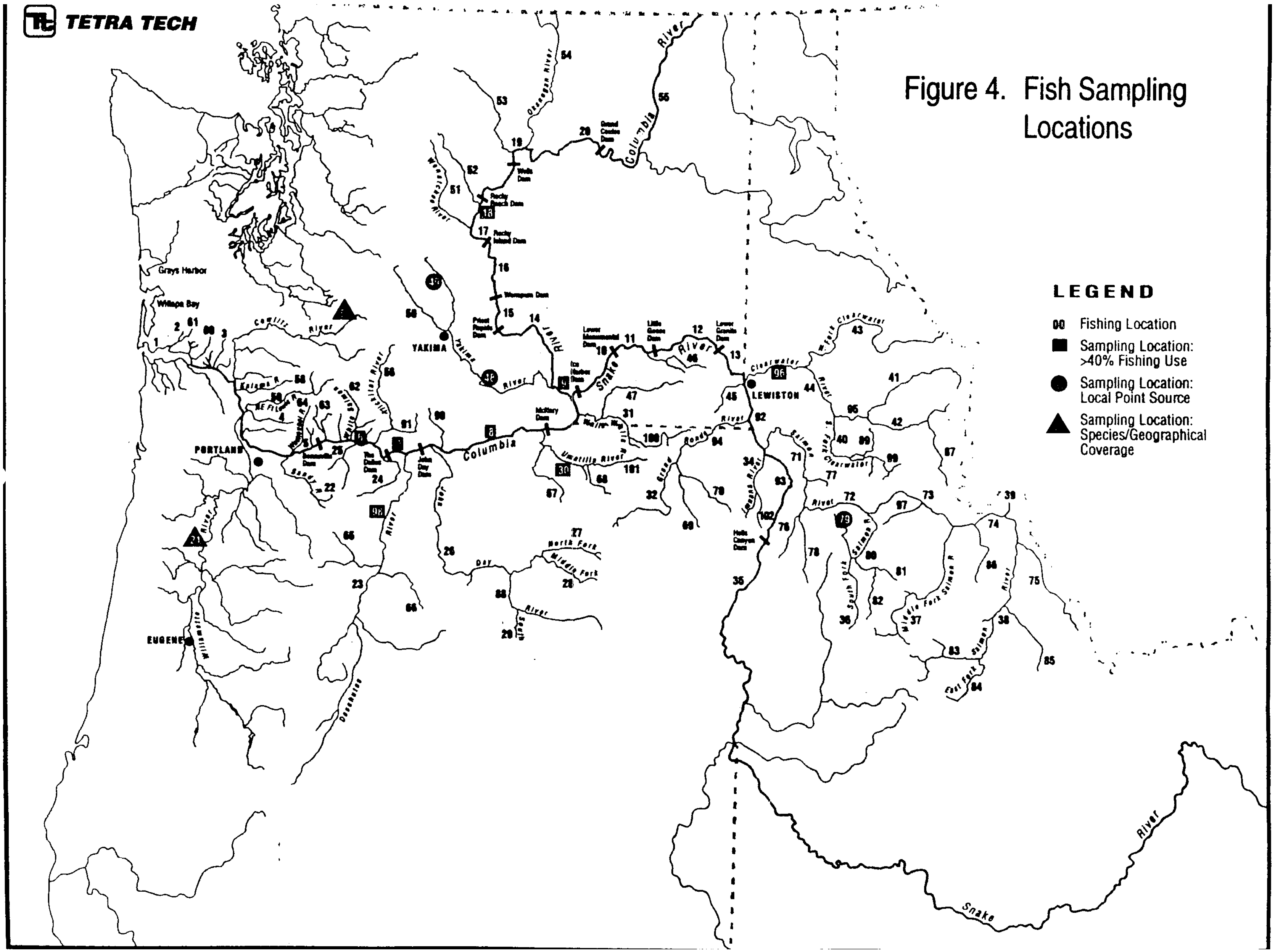

Figure 4. Fish Sampling Locations

The two remaining sites that are proposed for sampling were selected by considering a particular species of concern and the desire to provide broad geographical coverage of sampling sites (Figure 4). Site 57, in the Cowlitz River, was selected to provide contaminant data for smelt. Fifty-two percent of adult tribal members consume smelt (CRITFC 1994). Because this fish species has a high oil content, it may accumulate higher levels of hydrophobic organic contaminants than other anadromous species; therefore, CRITFC Task Force members felt it was important to include sampling at site 57. Site 21, in the Willamette River, was selected to provide additional geographic coverage, and to provide contaminant data for lamprey, which are consumed by 54 percent of adult tribal members (CRITFC 1994).

2.2 SELECTION OF SPECIES

The selection of species to be analyzed was based primarily on consumption data presented in CRITFC (1994). Table 2 shows the fish species that are consumed by tribal members and the proposed fishing sites where the species will be collected. Tissue samples for all consumed species except squawfish and shad will be analyzed. These two species are consumed by only a small fraction (<2.7 percent) of adult tribal members.

2.3 SAMPLE TYPE

Figure 5 shows the locations, species, and sample types that will be analyzed during EPA's Phase II study. Four types of samples will be analyzed: whole-body (WB), fillet with skin (F_s), fillet without skin (F_W), and eggs (E). Whole-body samples were selected for several species to maximize the chances of measuring detectable levels of contaminants of concern and because data presented in CRITFC (1984) show that tribal members may consume several fish parts in addition to the fillet (Table 3). Eggs from spring chinook, fall chinook, and steelhead will be analyzed because consumption data shows that salmonid eggs are widely consumed by tribal members (Table 3). Because of the high lipid levels in eggs, concentrations of hydrophobic organic chemicals may reach substantially higher levels than in other fish tissues. Design Conference attendees felt that it was important to determine contaminant levels in various fish

TABLE 2. PERCENTAGE OF ADULT TRIBAL MEMBERS CONSUMING PROPOSED TARGET SPECIES AND FISHING SITES WHERE THESE SPECIES WILL BE COLLECTED

Species	Weighted Percent That Consume the Species	Proposed Fishing Sites	
		Site Numbers	Site Locations (Rivers)
Salmon	92.4%	21, 8, 9, 18, 30, 96	Willamette, Columbia, Umatilla, Clearwater
Lamprey	54.2%	21, 6	Willamette, Columbia
Trout [a]	70.2%	98, 8, 18, 30, 48, 49, 96,79	Deschutes, Columbia, Umatilla, Yakima, Clearwater, Salmon
Smelt	52.1%	57	Cowlitz
Whitefish	22.8%	8, 30, 96	Columbia, Umatilla, Clearwater
Sturgeon	24.8%	6, 7, 8, 9, 96	Columbia, Clearwater
Walleye	9.3%	98, 8, 48	Deschutes, Columbia, Yakima
Sucker	7.7%	98	Deschutes
Squawfish	2.7%	none	none
Shad	2.6%	none	none

Source: Modified from CRITFC (1994).

[a] Rainbow Trout and Steelhead.

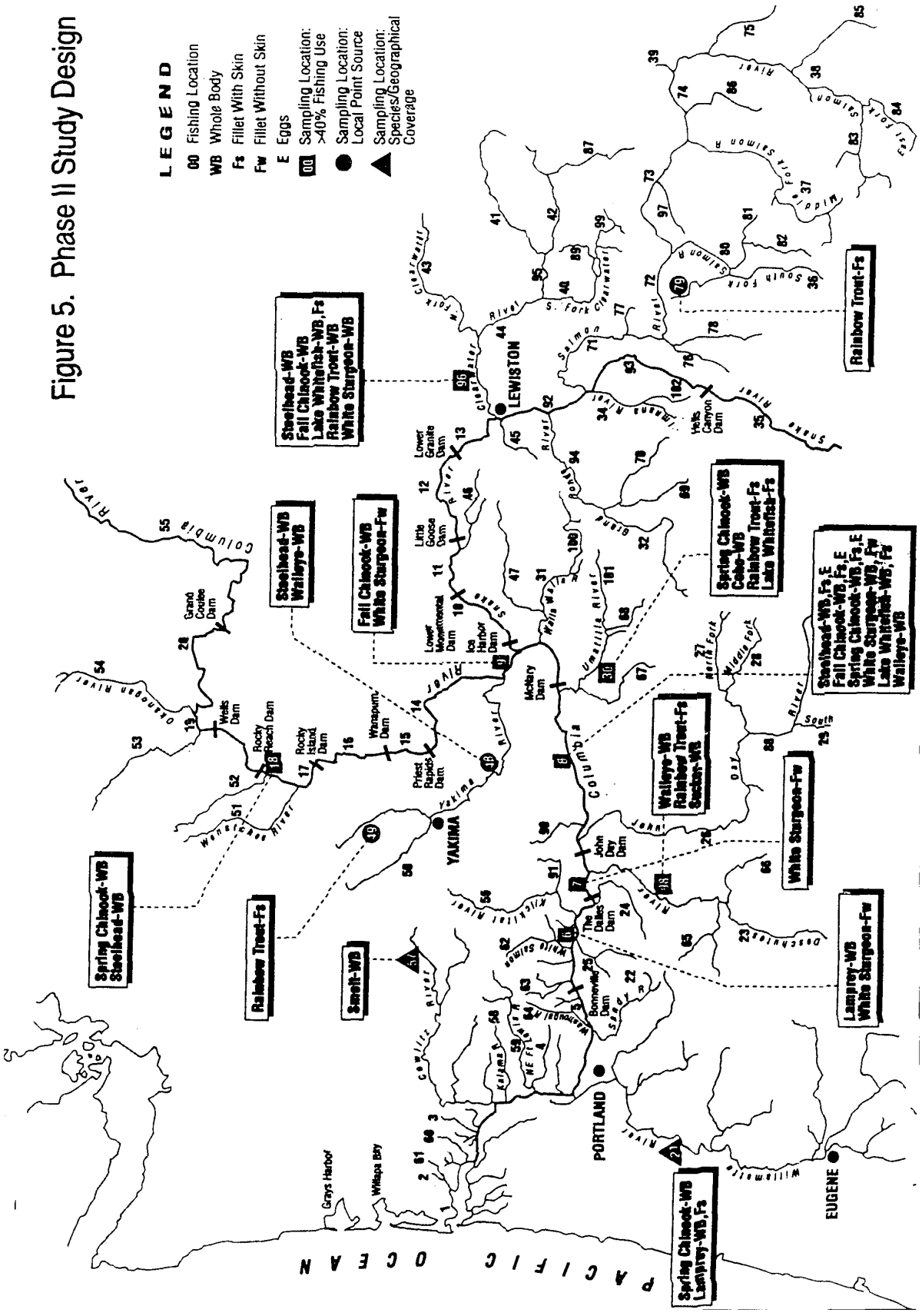
Figure 5. Phase II Study Design
LEGEND
00 Fishing Location
WB Whole Body
Fs Fillet With Skin
Fw Fillet Without Skin
E Eggs
Sampling Location: >40% Fishing Use
Sampling Location: Local Point Source
Sampling Location: Species/Geographical Coverage
Steelhead-WB Fall Chinook-WB Lake Whitefish-WB,Fs Rainbow Trout-WB White Sturgeon-WB
Steelhead-WB Walleye-WB
Fall Chinook-WB White Sturgeon-Fw
Spring Chinook-WB Cisco-WB Rainbow Trout-Fs Lake Whitefish-Fs
Steelhead-WB,Fs,E Fall Chinook-WB,Fs,E Spring Chinook-WB,Fs,E White Sturgeon-WB,Fs,E Lake Whitefish-WB,Fs Walleye-WB
Walleye-WB Rainbow Trout-Fs Sucker-WB
White Sturgeon-Fw
Lamprey-WB White Sturgeon-Fw
Spring Chinook-WB Lamprey-WB,Fs
Rainbow Trout-Fs
Spring Chinook-WB Steelhead-WB
Rainbow Trout-Fs
Smelt-WB
LEWISTON
YAKIMA
PORTLAND
EUGENE
PACIFIC OCEAN
Columbia River
Snake River
Yakima River
Willamette River
Clearwater River
Grande Ronde River
John Day River
Deschutes River
Umatilla River
Walla Walla River
Lower Granite Dam
Little Goose Dam
Lower Monumental Dam
Ice Harbor Dam
McNary Dam
John Day Dam
The Dalles Dam
Bonneville Dam
Priest Rapids Dam
Wanapum Dam
Rocky Reach Dam
Rock Island Dam
Wells Dam
Grand Coulee Dam
Hells Canyon Dam
Grays Harbor
Willapa Bay

TABLE 3. COLUMBIA RIVER INTER-TRIBAL FISH COMMISSION EXPOSURE STUDY. ADULT CONSUMPTION OF FISH PARTS

Species	Parts											
	Fillet		Skin		Head		Eggs		Bones		Organs	
	N	Weighted % That Consume	N	Weighted % That Consume	N	Weighted % That Consume	N	Weighted % That Consume	N	Weighted % That Consume	N	Weighted % That Consume
Salmon	473	95.1%	473	55.8%	473	42.7%	473	42.8%	473	12.1%	470	3.7%
Lamprey	249	86.4%	251	89.3%	250	18.1%	250	4.6%	250	5.2%	250	3.2%
Trout	365	89.4%	365	68.5%	365	13.7%	364	8.7%	365	7.1%	362	2.3%
Smelt	209	78.8%	209	88.9%	210	37.4%	209	46.4%	210	28.4%	206	27.9%
Whitefish	125	93.8%	124	53.8%	125	15.4%	125	20.6%	125	6.0%	124	0.0%
Sturgeon	121	94.6%	121	18.2%	121	6.2%	121	11.9%	121	2.6%	121	0.3%
Walleye	46	100%	46	20.7%	46	6.2%	46	9.8%	46	2.4%	46	0.9%
Sucker	15	89.7%	15	34.1%	15	8.1%	15	11.1%	15	5.9%	15	0.0%
Squawfish	42	89.3%	42	50.0%	42	19.4%	42	30.4%	42	9.8%	42	2.1%
Shad	16	93.5%	16	15.7%	16	0.0%	16	0.0%	16	3.3%	15	0.0%

Source: CRITFC (1994).

parts (i.e., whole-body, fillet, and eggs) so that this information could be used to provide guidance on how to prepare fish, or what parts should be avoided, in the event that contaminant levels exceed levels that warrant concern. In addition, the conversion factors developed from this data (e.g., whole-body: fillet and whole-body; egg ratios) may assist in the comparison of Phase II data with other historical data that exist within the Columba River Basin. Figure 5 indicates that most of the comparisons of contaminant levels in different fish samples will occur at Site 8 in the Columbia River between the McNary and John Day dams. This site was selected because of its importance as a fishing site for all four CRITFC member tribes.

2.4 SAMPLING STRATEGY

The sampling strategy proposed for this study design is consistent with guidance provided in the document entitled: *Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories*, Volume I: Fish Sampling and analysis (U.S. EPA 1993b). For all fish species except white sturgeon, three replicate composite samples will be analyzed from each collection site. For white sturgeon, one sample from three individual fish will be analyzed from each collection site. The number of fish per composite will likely vary for different species: 20 individuals per composite for smelt and lamprey, 8 individuals per composite for resident species, and 5 individuals per composite for salmon and steelhead (Table 4). U.S. EPA (1993b) recommends that 3 to 10 individuals should be collected for a composite sample for each target species and that the same number of individual organisms should be used to prepare all replicate composite samples for a given target species at a given site. Several ongoing fish contaminant studies in the Columbia river Basin are compositing 8 individuals per sample, so the use of this number would simplify comparisons with other available data. Because of the small size of lamprey and smelt, a composite of 8 individuals would not provide enough tissue for all chemical analyses; therefore a nominal value of 20 individuals per composite was suggested for these species. Design

Conference attendees felt that the number of individuals per composite for salmon and steelhead should be reduced from 8 to 5 (some individuals suggested 3) because of concerns about the ability to collect sufficient numbers of fish, and because it was felt that the study should strive to minimize impacts on these fish stocks.

Collection periods for each species have been tentatively assigned and are given in Table 5. According to U.S. EPA guidance (U.S. EPA 1993b), the collection period should ideally avoid the spawning period of the target species, because many fish are subject to stress during spawning. However, because eggs will be collected from salmonid species, the typical spawning period for these species will be targeted (WDF/ODFW 1993). For resident species, wide collection periods have been proposed so that spawning periods can be avoided (Table 5). For white sturgeon, the proposed collection period is consistent with seasons established in previous years (WDF/ODFW 1994).

TABLE 4. STUDY DESIGN FOR ASSESSMENT OF CHEMICAL CONTAMINANTS IN FISH CONSUMED BY CRITFC MEMBER TRIBES

Species	Classification	Fishing Site[a]	Waterbody	Sample Type[b]	Number of Composite Samples	Number of Individual Samples	Number of Fish per Composite	Total Number of Fish
Smelt	Anadromous	57	Cowlitz River	WB	3	--	20	60
Lamprey	Anadromous	21	Willamette River	WB, Fs	6	--	20	120
		6	Columbia River	WB	3	--	20	60
Steelhead	Anadromous	8	Columbia River	WB, Fs, E	9	--	5	30[c]
		18	Columbia River	WB	3	--	5	15
		48	Yakima River	WB	3	--	5	15
		96	Clearwater River	WB	3	--	5	15
Coho	Anadromous	30	Umatilla River	WB	3	--	5	15
Chinook (Fall)	Anadromous	8	Columbia River	WB, Fs, E	9	--	5	30[c]
		9	Columbia River	WB	3	--	5	15
		96	Clearwater River	WB	3	--	5	15
Chinook (Spring)	Anadromous	21	Willamette River	WB	3	--	5	15
		8	Columbia River	WB, Fs, E	9	--	5	30[c]
		18	Columbia River	WB	3	--	5	15
		30	Umatilla River	WB	3	--	5	15
Rainbow Trout	Resident	98	Deschutes River	Fs	3	--	8	24
		49	Yakima River	Fs	3	--	8	24
		96	Clearwater River	WB, Fs	6	--	8	48
		30	Umatilla River	Fs	3	--	8	24
		79	Salmon River	Fs	3	--	8	24
White Sturgeon	Resident	6	Columbia River	Fw	--	3	--	3
		7	Columbia River	Fw	--	3	--	3
		8	Columbia River	WB, Fw	--	6	--	6
		9	Columbia River	Fw	--	3	--	3
		96	Clearwater River	WB	--	3	--	3
Lake Whitefish	Resident	8	Columbia River	WB, Fs	6	--	8	48
		30	Umatilla River	Fs	3	--	8	24
		96	Clearwater River	WB	3	--	8	24
Largescale Sucker	Resident	98	Deschutes River	WB	3	--	8	24
Walleye	Resident	98	Deschutes River	WB	3	--	8	24
		48	Yakima River	WB	3	--	8	24
		8	Columbia River	WB	3	--	8	24
TOTALS		13 sites	8 Rivers	4 Sample Types	105	18		819

[a] Nominal collection areas.
[b] WB = Whole body, Fs = Fillet with skin, Fw = Fillet without skin, E = Eggs.
[c] Assumes eggs will be removed from whole-body samples and analyzed separately.

TABLE 5. COLUMBIA RIVER INTER-TRIBAL FISH COMMISSION EXPOSURE STUDY

Study Design for the Columbia River InterTribal Fish Commission Exposure Study

Site	Receiving Water	Anadromous Fish Species (Sex)	Sample Type[b]	Collection Period[a]	Resident Fish Species (Sex)	Sample Type[b]	Collection Period	Number of Samples at Site[c]
48	Yakima River	Steelhead (F)	WB	Dec-June	Walleye	WB	Jan-Dec	6
18	Columbia River	Spring Chinook (F) Steelhead (F)	WB WB	Sept-Nov Dec-June	--	--	--	6
9	Columbia River	Fall Chinook (F)	WB	Sept-Oct	White Sturgeon	Fw	Jan-Mar	6
57	Cowlitz River	Smelt (F)	WB	Feb	--	--	--	3
6	Columbia River	Lamprey	WB	June-July	White Sturgeon	Fw	Jan-Mar	6
7	Columbia River	--	--	--	White Sturgeon	Fw	Jan-Mar	3
8	Columbia River	Spring Chinook (F) Fall Chinook (F) Steelhead (F)	WB, Fs, E WB, Fs, E WB, Fs, E	Sept-Nov Sept-Oct Dec-June	White Sturgeon Lake Whitefish Walleye	WB, Fw WB ,Fs WB	Jan-Mar Jan-Dec Mar-June	42
49	Yakima River	--	--	--	Rainbow Trout	Fs	Mar-June	3
96	Clearwater River	Steelhead (F) Fall Chinook (F)	WB WB	Dec-June Sept-Oct	Lake Whitefish Rainbow Trout White Sturgeon	WB, Fs WB WB	Late July Mar-June Jan-Mar	18
79	Salmon River	--	--	--	Rainbow Trout	Fs	Mar-June	3
30	Umatilla River	Spring Chinook (F) Coho (F)	WB WB	Sept-Nov Oct-Dec	Rainbow Trout (F) Lake Whitefish (F)	Fs Fs	June-Dec Jan-Dec	12
98	Deschutes River	--	--	--	Rainbow Trout Largescale Sucker Walleye	Fs WB WB	Mar-June Jan-Dec Mar-June	9
21	Willamette River	Spring Chinook (F) Lamprey	WB WB, Fs	Sept-Nov June-July	--	--	--	9
							Total +12QA	126 138

WB = Whole body, Fs = Fillet with skin, Fw = Fillet without skin, E = Eggs.

[a] Dates reflect typical spawning times. Source: Status Report. Columbia River Fish Runs and Fisheries 1938-1992 (WDF/ODFW 1993).

[b] Samples from all species except sturgeon are composites from 5-20 individuals. Sturgeon samples are from individual fish.

[c] Number of samples assumes each tissue sample performed in triplicate, each sediment sample performed in quadruplicate.

2.5 TARGET ANALYTES

Target analytes were selected by considering the guidance provided in U.S. EPA (1993b) and by performing a health risk-based screening analysis of tissue contaminant data collected within the Columbia River Basin during the last ten years (1984-1994). The exposure assumptions used to perform the screening analysis are given in Table 6. Screening for carcinogens was performance for a 70 kg adult using a target cancer risk of 1×10^{-6}. Screening for non-carcinogens was performed for a 14.5 kg child using a target hazard quotient of 0.1. Fish consumption rates assumed for adults and children were 194 and 81 g/day, respectively, which correspond to the cumulative 97^{th} percentile consumption rate reported in CRITFC (1994). For chemicals that had both slope factors for estimating carcinogenic risk and reference does for estimating non-carcinogenic risk, separate tissue screening concentrations (STCs) were calculated and the lower of the two values was used for the screening analysis. Chemical concentrations reported as not detected were assumed to be equal to one half the detection limit for the screening analysis.

Table 7 lists the chemicals that exceeded tissue screening concentrations (STCs) and the frequency of exceedances. Chemicals that exceeded STCs include dioxins/furans, PCBs, organochlorine and organophosphorus pesticides, PAHs and other semivolatiles, trace metals, and radionuclides. Table 8 provides a list of the chemicals that did not exceed STCs. It should be noted that the tissue screening analysis could only be conducted for chemicals that have established slope factors or reference doses; therefore, Table 8 includes chemicals that do not have either of these toxicological reference values.

The final list of chemicals that will be analyzed during the Phase II study will be presented in a sampling and QA/QC plan that will be prepared prior to initiating sampling. This document will also provide the analytical methods and quantitation levels expected for the laboratory analyses. The chemical groups expected to be analyzed and a preliminary listing of the methods that may be

employed are provided below:

TABLE 6. EXPOSURE ASSUMPTIONS FOR SCREENING FISH TISSUE CHEMICAL CONCENTRATIONS

	Cancer	Non-Cancer
Target Cancer Risk	1×10^{-6}	
Target hazard quotient		0.1
Body weight - Adult (kg)	70	
Body weight - Child (kg)		14.5
Averaging time - Adult (years of life)	70	
Averaging time - Child (years of life)		10
Exposure frequency (days/year)	365	365
Fish ingestion rate - Adult (grams/day)	194[b]	
Fish ingestion rate - Child (grams/day)		81[b]

Oral carcinogenic slope factors and oral reference doses were obtained from IRIS or HEAST.

[a] This value is the 97th percentile consumption rate for fish consumers cited in Phase I of this project. CRITFC (1994). Table 10.

[b] This value is the 97.4th percentile consumption rate for fish consumers cited in Phase II of this project. CRITFC (1994). Table 24.

TABLE 7. CHEMICALS THAT EXCEEDED TISSUE SCREENING CONCENTRATIONS
(Page 1 of 5)

Chemical Group	Chemical	Screening Tissue Concentration (STC) (μg/kg)[a]	STC Classification[b]	Total Measurements	Number Detected	Maximum Concentration (μg/kg)[a]	Total Number of STC Exceedances	Frequency of STC Exceedances
Dioxins/furans	1,2,3,4,6,7,8-HpCDD	0.000024	C	264	142	0.09172	264	100.0%
	1,2,3,4,6,7/1,2,3,4,7,8-HxCDF	0.000024	C	10	0	0.001385	10	100.0%
	1,2,3,4,7,8-HxCDD	0.000024	C	265	54	0.01885	265	100.0%
	1,2,3,6,7,8-HxCDD	0.000024	C	265	77	0.049	265	100.0%
	1,2,3,7,8,9-HxCDD	0.000024	C	265	38	0.00336	265	100.0%
0.24ppt	1,2,3,7,8-PeCDD	0.000005	C	229	61	0.009	229	100.0%
	2,3,4,6,7,8-HxCDF	0.000024	C	228	73	0.0115	228	100.0%
	2,3,7,8-TCDD	0.000002	C	548	323	0.05602	548	100.0%
	2,3,7,8-TCDF	0.000024	C	541	511	0.32069	541	100.0%
	2,3,4,7,8-PeCDF	0.000005	C	229	80	0.01902	228	99.6%
	1,2,3,7,8,9-HxCDF	0.000024	C	192	37	0.0045	188	97.9%
	1,2,3,7,8-PeCDF	0.000048	C	229	79	0.05432	221	96.5%
	1,2,3,6,7,8-HxCDF	0.000024	C	192	37	0.0056	182	94.8%
	1,2,3,4,7,8-HxCDF	0.000024	C	182	34	0.003	172	94.5%
	TOTAL HxCDD	0.000058	C	47	4	0.001	36	76.6%
	OCDD	0.0024	C	182	142	1	135	74.2%
	1,2,3,4,6,7,8-HpCDF	0.00024	C	192	50	0.0055	104	54.2%
	1,2,3,4,7,8,9-HpCDF	0.00024	C	228	25	0.002665	121	53.1%
	OCDF	0.0024	C	182	61	0.036	8	4.4%
PCBs	Aroclor 1016	0.047	C	109	0	25	109	100.0%
	Aroclor 1221	0.047	C	220	0	100	220	100.0%
	Aroclor 1232	0.047	C	220	1	40	220	100.0%
	Aroclor 1242	0.047	C	187	2	121	187	100.0%
	Aroclor 1242/1016	0.047	C	33	0	26	33	100.0%
	Aroclor 1248	0.047	C	143	1	100	143	100.0%
	Aroclor 1254	0.047	C	231	74	2700	231	100.0%
	Aroclor 1260	0.047	C	268	82	1403	268	100.0%
	TOTAL PCBs	0.047	C	328	132	2043.1	326	99.4%

TABLE 7. CHEMICALS THAT EXCEEDED TISSUE SCREENING CONCENTRATIONS
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Chemical Group	Chemical	Screening Tissue Concentration (STC) (μg/kg)[a]	STC Classification[b]	Total Measurements	Number Detected	Maximum Concentration (μg/kg)[a]	Total Number of STC Exceedances	Frequency of STC Exceedances
Pesticides Organochlorines	Aldrin	0.021	C	269	10	103	269	100.0%
	alpha-BHC	0.057	C	433	28	39	433	100.0%
	beta-BHC	0.20	C	412	14	150	412	100.0%
	Chlordane	0.28	C	184	3	70	184	100.0%
	Chlordane (tech)	0.28	C	23	18	144	23	100.0%
	Dicofol	0.82	C	186	17	300	186	100.0%
	Dieldrin	0.023	C	478	113	352	478	100.0%
	gamma-BHC	0.28	C	425	27	50	425	100.0%
	gamma-Chlordane	0.28	C	249	40	60	249	100.0%
	Heptachlor	0.080	C	287	22	68	287	100.0%
	Heptachlor epoxide	0.040	C	431	17	20	431	100.0%
	Lindane	0.28	C	5	0	5	5	100.0%
	o,p'-DDE	1.1	C	313	43	65	313	100.0%
	o,p'-DDT	1.1	C	313	42	105	313	100.0%
	Pentachlorophenol	3.0	C	129	0	6000	129	100.0%
	TOTAL BHC	0.28	C	29	3	160	29	100.0%
	Total Chlordane	0.28	C	29	18	200	29	100.0%
	TOTAL DDT	1.1	C	60	57	3000	60	100.0%
	Toxaphene	0.33	C	311	38	1200	311	100.0%
	Hexachlorobenzene	0.23	C	334	24	250	333	99.7%
	alpha-Chlordane	0.28	C	234	58	50	233	99.6%
	Endosulfan II	0.90	N	227	7	50	214	94.3%
	Endosulfan I	0.90	N	227	12	148	213	93.8%
	p,p'-DDE	1.1	C	498	391	3400	466	93.6%
	p,p'-DDT	1.1	C	473	215	960	424	89.6%
	o,p'-DDD	1.5	C	313	72	130	262	83.7%
	p,p'-DDD	1.5	C	430	214	420	330	76.7%
	Endosulfan	3.6	N	49	6	170	36	73.5%

TABLE 7. CHEMICALS THAT EXCEEDED TISSUE SCREENING CONCENTRATIONS
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Chemical Group	Chemical	Screening Tissue Concentration (STC) (μg/kg)[a]	STC Classification[b]	Total Measurements	Number Detected	Maximum Concentration (μg/kg)[a]	Total Number of STC Exceedances	Frequency of STC Exceedances
Pesticides (Cont.)	Mirex	3.6	N	262	5	50	180	68.7%
	Endrin	5.4	N	467	17	61	59	12.6%
	Methoxychlor	89.5	N	240	10	832	9	3.8%
Organophosphate	Methyl parathion	4.5	N	106	6	38	55	51.9%
Semi-Volatiles	2,4,6-Trichlorophenol	32.8	C	129	0	1250	129	100.0%
	2,4-Dichlorophenol	53.7	N	129	0	750	129	100.0%
	2,4-Dinitrophenol	35.8	N	128	0	2500	128	100.0%
	2,4-Dinitrotoluene	35.8	N	129	1	1250	129	100.0%
	2,6-Dinitrotoluene	0.53	C	129	0	1250	129	100.0%
	3,3'-Dichlorobenzidine	0.80	C	129	0	1250	129	100.0%
	Benzidine	0.0016	C	23	0	815	23	100.0%
	Bis(2-chloroethyl)ether	0.33	C	258	0	250	258	100.0%
	Bis(2-chloroisopropyl)ether	5.2	C	258	0	250	258	100.0%
	Bis(2-ethylhexyl)phthalate	25.8	C	129	51	34200	129	100.0%
	Hexachlorocyclopentadiene	125.3	N	127	0	1305	127	100.0%
	Hexachloroethane	17.9	C	129	0	250	129	100.0%
	N-Nitroso-di-n-propylamine	0.052	C	96	1	2900	96	100.0%
	N-Nitrosodimethylamine	0.0071	C	23	0	139	23	100.0%
	Nitrobenzene	9.0	N	129	0	250	129	100.0%
	Pyridine	17.9	N	23	0	139	23	100.0%
	Hexachlorobutadiene	4.6	C	146	0	250	128	87.7%
	Carbazole	18.0	C	73	0	250	56	76.7%
	4-Chloroaniline	71.6	N	54	0	750	35	64.8%
	2-Chlorophenol	89.5	N	129	1	4200	11	8.5%
	4-Nitrophenol	1109.9	N	129	2	4000	8	6.2%
	1,2,4-Trichlorobenzene	179.0	N	147	6	3100	9	6.1%
	Isophorone	379.8	C	105	7	430	1	1.0%
	2,4-Dimethylphenol	358.0	N	129	0	600	1	0.8%
	Butyl benzyl phthalate	3580.2	N	129	1	3700	1	0.8%
	Di-n-octylphthalate	358.0	N	129	1	2640	1	0.8%

TABLE 7. CHEMICALS THAT EXCEEDED TISSUE SCREENING CONCENTRATIONS
(Page 4 of 5)

Chemical Group	Chemical	Screening Tissue Concentration (STC) (μg/kg)[a]	STC Classification[b]	Total Measurements	Number Detected	Maximum Concentration (μg/kg)[a]	Total Number of STC Exceedances	Frequency of STC Exceedances
Semi-Volatile PAHs	Benz[a]anthracene	0.34	C	146	0	100	146	100.0%
	Benzo[a]pyrene	0.049	C	328	2	700	328	100.0%
	Benzo[b,k]fluoranthene	0.40	C	33	0	5	33	100.0%
	Benzo[b]fluoranthene	0.40	C	131	1	800	131	100.0%
	Benzo[k]fluoranthene	0.93	C	131	1	700	131	100.0%
	Chrysene	0.049	C	163	0	100	163	100.0%
	Dibenz[a,h]anthracene	0.045	C	146	0	200	146	100.0%
	Indeno[1,2,3-cd]pyrene	0.18	C	146	0	200	146	100.0%
	Benzo[g,h,i]perylene	2.3	C	162	0	200	142	87.7%
	Acenaphthene	1074.1	N	147	3	3800	1	0.7%
	Pyrene	537.0	N	163	3	5200	1	0.6%
Trace Metals	Arsenic	0.21	C	267	126	1860	267	100.0%
	Beryllium	0.084	C	40	2	60	40	100.0%
	Manganese	89.5	N	45	45	24200	45	100.0%
	Mercury	5.4	N	335	321	100000	334	99.7%
	Lead	7.7	N	298	220	23300	287	96.3%
	Cadmium	9.0	N	291	215	5910	250	85.9%
	Zinc	5370.4	N	297	296	136000	241	81.1%
	Selenium	89.5	N	207	91	2500	158	76.3%
	Antimony	7.2	N	170	20	2200	114	67.1%
	Nickel	358.0	N	136	57	17290	84	61.8%
	Barium	1253.1	N	144	117	47200	84	58.3%
	Copper	662.3	N	297	281	66900	173	58.2%
	Silver	89.5	N	136	39	1540	66	48.5%
	Chromium	89.5	N	102	69	620	44	43.1%

TABLE 7. CHEMICALS THAT EXCEEDED TISSUE SCREENING CONCENTRATIONS
(Page 5 of 5)

Chemical Group	Chemical	Screening Tissue Concentration (STC) (μg/kg)[a]	STC Classification[b]	Total Measurements	Number Detected	Maximum Concentration (μg/kg)[a]	Total Number of STC Exceedances	Frequency of STC Exceedances
Radionuclides	Americium 241	0.00084	C	33	0	0.0135	33	100.0%
	Cesium 137	0.0072	C	33	2	0.06	33	100.0%
	Europium 152	0.096	C	33	0	0.2	33	100.0%
	Europium 154	0.067	C	33	0	0.125	33	100.0%
	Plutonium 238	0.00092	C	33	1	0.011	33	100.0%
	Plutonium 239/240	0.00088	C	33	16	0.0055	31	93.9%
	Cobalt 60	0.013	C	33	0	0.075	16	48.5%

[a] All concentrations are reported in units of μg/kg wet weight, except for radionuclides. Radionuclide concentrations are reported as pCi/g wet weight.

[b] C = Carcinogen, N = Non-carcinogen.

TABLE 8. CHEMICALS THAT DID NOT EXCEED TISSUE SCREENING CONCENTRATIONS

Chemical Group	Chemical	Screening Tissue Concentration (STC) (ug/kg)[a]	STC Classification[b]	Total Measurements	Number Detected	Maximum Concentration (ug/kg)[a]	Total Number of STC Exceedances
Pesticides							
Dinitroanilines	Isopropalin	268.5	N	18	0	1.25	0
	Trifluralin	134.3	N	18	1	7.16	0
Organochlorines	Dacthal	8950.6	N	81	9	50	0
	Pentachloronitrobenzene	1.4	C	18	0	1.25	0
Organophosphates	Chlorpyrifos	53.7	N	18	1	3.44	0
	Malathion	358.0	N	72	2	110	0
	Parathion	107.4	N	72	3	26	0
Radionuclides	Europium 155	0.45	C	33	0	0.25	0
Semi-Volatiles	1,2,4,5-Tetrachlorobenzene	5.4	N	18	2	1.61	0
	1,2-Dichlorobenzene	1611.1	N	129	0	250	0
	1,3-Dichlorobenzene	1593.2	N	129	0	250	0
	2,4,5-Trichlorophenol	1790.1	N	56	0	1250	0
	2-Methylphenol	895.1	N	129	0	326	0
	4-Bromophenyl phenyl ether	1038.3	N	129	0	250	0
	Benzoic acid	71604.9	N	56	3	2500	0
	Benzyl Alcohol	17901.2	N	56	2	250	0
	Di-n-butylphthalate	1790.1	N	129	10	1550	0
	Diethyl phthalate	14321.0	N	129	0	250	0
	Dimethyl phthalate	1790.1	N	129	0	326	0
	Pentachlorobenzene	14.3	N	18	1	1.25	0
	Phenol	10740.7	N	129	10	5000	0
Semi-Volatile PAHs	2-Chloronaphthalene	1432.1	N	129	0	250	0
	Anthracene	5370.4	N	163	0	100	0
	Fluoranthene	716.0	N	163	10	100	0
	Fluorene	716.0	N	163	3	100	0
	Naphthalene	716.0	N	164	26	500	0
	Phenanthrene	519.1	N	163	12	100	0

[a] All concentrations are reported in units of ug/kg wet weight, except for radionuclides. Radionuclide concentrations are reported as pCi/g wet weight.

Analyte Group	Analytical Method
Dioxins/Furans	EPA 1613B
Coplanar PCBs	NFCRC C5.181
Pesticides/PCBs	EPA 8081
Semivolatile organics	EPA 8270
PAHs	EPA 8270 with selected ion monitoring (SIM)
Metals	EPA 6010A

A contract laboratory will be responsible for processing the collected fish samples and for analysis of dioxin/furans and coplanar PCBs. The U.S. EPA Manchester Laboratory in Port Orchard, Washington will be responsible for all other analyses.

The resources allocated for chemical analyses do not presently provide for the analysis of radionuclides in tissue. Design Conference attendees recommended that analysis of radionuclides be included in the Phase II study. EPA staff are currently trying to determine whether an EPA laboratory can perform these analyses; if so, they will be included in the study design. If an EPA laboratory cannot provide these analyses, radionuclides will not analyzed. This issue is expected to be resolved prior to the preparation of the draft sampling and QA/QC plan.

3.0 RECOMMENDATIONS

Design Conference attendees provided several recommendations that address a variety of issues relevant to the Phase II study and broader objectives for assessing the impacts of toxic contaminants and habitat degradation on fish stocks, ecological health, and human health. These recommendations are listed below.

3.1 GENERAL COMMENTS

- Studies should be designed with the goal of providing information that will allow better protection of natural resources.

- Ecological impairment should be evaluated. An ecological risk design conference should be held to develop specific objectives and a study plan for assessing ecological impairment.

- Regulatory agencies should coordinate their risk assessment activities to ensure that the public receives a consistent message.

- The methodology for conducting an assessment of human health for the CRITFC member tribes should be clearly delineated, as well as the form in which this information will be conveyed to the public.

3.2 COMMENTS SPECIFIC TO THE PHASE II STUDY

- A sampling and QA/QC document should be prepared for the Phase II study that includes a schedule for the project collection activities, report due dates, and peer review.

- Radionuclides should be analyzed.

- Composite samples should consist of fish within a specified size range. It is recommended that the size range include the larger fish within a given population, since these fish may contain higher contaminant burdens.

- A detailed study plan should be developed for determining biota-sediment-accumulation factors (BSAFs) for the Columbia River Basin.

- The sampling and QA/QC plan for the Phase II study should include guidance on selecting alternative species, or locations, if sufficient numbers of the target species can not be collected.

- If resources are insufficient to collect all of the samples included in this study design, it is recommended that the following samples, in order listed, be eliminated: largescale sucker at site 98, fall chinook at site 96.

- Any observed external anomalies in the fish collected should be collected.

- The inclusion in the study design of pathological analyses and measurement of fish hormone levels of fish collected should be considered.

4.0 REFERENCES

CRITFC (Columbia River Inter-Tribal Fish Commission). 1994. A fish consumption survey of the Umatilla, Nez Perce, Yakima, and Warm Springs Tribes of the Columbia River Basin. CRITFC Technical Report No. 94-3. Portland, Oregon.

Hatcher, L. 28 September 1994. Personal communication (Telephone conversation with Dr. Steve Ellis, Tetra Tech, Inc., Redmond, Washington). Yakima Indian Nation, Fisheries Resource Management, Toppenish, Washington.

Tetra Tech, Inc., 1993. Reconnaissance survey of the lower Columbia River. Task 6: Reconnaissance report (3 volumes). Prepared for Columbia River bi-State Committee. Tetra Tech, Inc., Redmond, Washington. Volume I - 454 pp + appendices. Volume 2 - Appendix A, Data Validation Reports - 361 pp. Volume 3 - Data Tables, Appendices B, C, D, and E - 314 pp.

Tetra Tech, Inc., 1994a. Assessing human health risks from chemically contaminated fish in the lower Columbia River. Sampling and Quality Assurance/Quality Control Plan. Prepared for the Columbia River Bi-State Program. Tetra Tech, Inc., Redmond, Washington.

Tetra Tech, Inc., 1994b. Lower Columbia River backwater reconnaissance survey (3 volumes). Prepared for the Columbia River Bi-State Program. Tetra Tech, Inc., Redmond, Washington.

US Environmental Protection Agency, 1993a. Interim report on data and methods for assessment of 2,3,7,8-tetrachlorodibenzo-p-dioxin risks to aquatic life and associated wildlife. EPA/600/R-93/055. US environmental Protection Agency, Office of Research and Development, Washington, DC.

US Environmental Protection Agency, 1993b. Guidance for assessing chemical contaminant data for use in fish advisories. Volume I: Fish sampling and analysis. EPA 823-R-93-002. US Environmental Protection Agency, Office of Water, Washington, DC.

Washington Department of Fisheries/Oregon Department of Fish and Wildlife (WDF/ODFW), 1993. Status Report. Columbia River Fish Runs and Fisheries, 1938-1992. Washington Department of Fisheries, Olympia, Washington. Oregon Department of Fish and Wildlife, Portland, Oregon.

Washington Department of Fisheries/Oregon Department of Fish and Wildlife (WDF/ODFW), 1994. Joint staff report concerning commercial seasons for spring chinook, sturgeon, shad, and other fisheries and miscellaneous regulations for 1994. Joint Columbia River Management Staff. Washington Department of Fisheries, Olympia, Washington. Oregon Department of Fish and Wildlife, Portland, Oregon.